

# Goldenrod Gall Flies on Sharkey Site: If You Build it They Will Come

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Restoration of ecological function to abandoned agricultural fields managed for forested ecosystems through afforestation can be measured in various ways. One underutilized method is to chart the progress of known predator-prey-parasitoid systems, and assess the development toward equilibrium of these systems across the forest restoration site. We study the development of the balancing selection system (described in detail by Abrahamson and Weis 1997) of goldenrod gallflies (*Eurosta solidaginis*) with their avian predators and insect parasitoids. The *Eurosta solidaginis* – predator – parasitoid system involves a plant host, *Solidago altissima*; a primary gall forming herbivore, *E. solidaginis*; and five enemies of the fly. Two are avian predators, a woodpecker, *Picoides pubescens*, and a tit, *Poecile atricapillus*; two hymenopteran parasitoids, *Euryfoma gigantea*, and *E. obtusiventris*; and a coleopteran predator/inquiline, *Mordellistena unicolor*. Abrahamson and Weis (1997) summarize the complex relationships among these species. They consider as primary the interaction between the interest of the fly to reproduce and of the plant to resist attack. They note an order of attack by the enemies of the fly: *E. obtusiventris* – *E. gigantea* – *M. unicolor* – birds, and consider the selective forces driving each interaction. Balancing selection on gall size occurs in this system as a result of an indirect interaction between birds (selecting against large galls by their visual foraging techniques) and *E. gigantea* (selecting against small galls by limitation of ovipositor morphology). We hypothesized that the effects of this balancing selection would vary along a continuum of distance from trees across the afforestation treatments because the bird species prefer stands of trees and hedgerows as habitat. This is the first such study in the southeastern U.S.A. We conducted this work in Sharkey Co., Mississippi, USA, on a large-scale restoration experiment (Schweitzer et al. 1997). This Sharkey Large Scale Experiment, initiated before the 1995 growing season, consists of a complete randomized block design with four separate forest restoration treatments in 8 ha plots: natural regeneration, sown *Quercus nuttallii* acorns, planted *Q. nuttallii* seedlings, and planted *Populus deltoides* with under-planted *Q. nuttallii* seedlings. We assessed the fates of a total of 5055 galls (in 44 samples) on *Solidago altissima*, collected in December 1998 and February 1999, at four distances from adjacent trees (10, 50, 125, and 400 m), representing each of the four treatments of the experiment. Four growing seasons after initiation of forest restoration, all major components of the *E. solidaginis* system were present, except that the local tit, *P. carolinensis*, does not depredate galls to the same extent as its northern congener. We found that woodpecker predators did indeed select larger galls

as was predicted by Abrahamson and Weis (1997), and that woodpecker predation as a source of mortality declined **rapidly with distance** from trees. We observed all the other interactions found in mature goldenrod gall fly systems, but at rates suggesting that the system had not reached equilibrium in this restoration experiment after four growing seasons. Mortality rates associated with the insect parasitoids of *E. solidaginis* were lower than those observed in more northern and more mature systems. *E. gigantea* attacked smaller galls, but no relationship between rate of attack and distance was observed. An interesting relationship between gall size and status of *M. unicolor*, i.e., as predator vs. as inquiline, deserves further study. This particular system is ideal for study by a variety of researchers, including academic scientists, university undergraduates, and secondary school students.

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